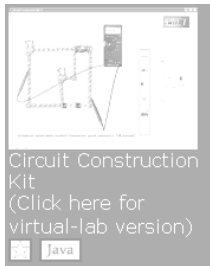
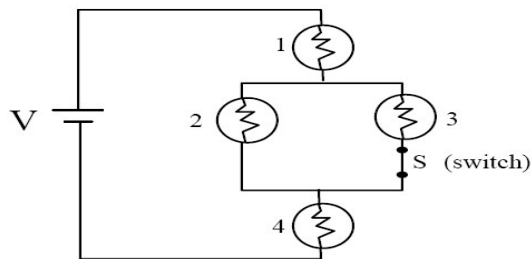


Using PhET Simulations to Verify Circuit Concepts

www.colorado.edu/physics/phet



In the following exercises you will first circle the answer that you think best describes the conditions in the circuit below. Then you will use the Phet Circuit Construction Kit to test your answers and calculate the required values. Use the default values with a 9 V battery and 10Ω resistor.



1. Which of the following correctly ranks the bulbs in brightness?
 - A. All bulbs are equally bright.
 - B. 1 is brightest, 2 next brightest, 3 next brightest and 4 dimmest
 - C. 1 is brightest. 2 and 3 are equally bright, and each is dimmer than 1. 4 is dimmest.
 - D. 1 and 4 are equally bright. 2 and 3 are equally bright, and each is dimmer than 1 or 4.
 - E. 2 and 3 are equally bright. 1 and 4 are equally bright, and each is dimmer than 2 or 3.
 - F. 1 is brightest, 4 is next brightest. 2 and 3 are equally bright, and each is dimmer than 4.
 - J. None of these is correct.

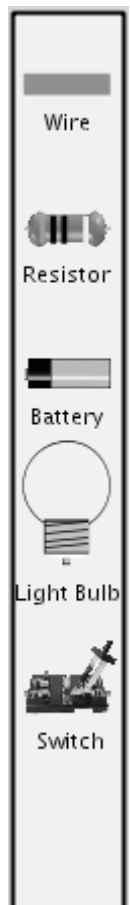
Now construct the above circuit with the PhET simulation. The number and brightness of the lines emanating from the light bulbs indicate their relative intensity. Power is responsible for the amount of brightness and $P = RI^2$. Now calculate the power output of each bulb by measuring the current (I) across each bulb with the Ammeter and finding its resistance (R) by right clicking on the bulb and choose “Change Resistance” to see current resistance value.

Bulb 1: _____ watts

Bulb 2: _____ watts

Bulb 3: _____ watts

Bulb 4: _____ watts



2. Which of the following correctly ranks the currents flowing through the bulbs?
- A. All bulbs have the same current flowing through them.
 - B. The current through 1 is largest, 2 next largest, 3 next largest and 4 smallest.
 - C. The current through 1 is largest. 2 is the same as 3, and each is smaller than 1. 4 is smallest.
 - D. The current through 1 and 4 is the same. 2 is the same as 3, and each is smaller than 1 or 4.
 - E. The current through 2 and 3 is the same. 1 is the same as 4, and each is smaller than 2 or 3.
 - F. The current through 1 is largest, 4 is next largest. 2 is the same as 3, and each is smaller than 4.
 - G. None of these is correct.

Use the Ammeter from the side bar, place it over the wire in the same branch with each bulb and record readings below.

I_1 : _____ I_2 : _____ I_3 : _____ I_4 : _____

3. Which of the following correctly ranks the potential differences across the bulbs?
- A. All bulbs have the same potential difference across them.
 - B. The potential difference across 1 is largest, 2 next largest, 3 next largest and 4 smallest.
 - C. The potential difference across 1 is largest. 2 is the same as 3, and each is smaller than 1. 4 is smallest.
 - D. The potential difference across 1 is the same as 4. 2 is the same as 3, and each is smaller than 1 or 4.
 - E. The potential difference across 2 is the same as 3. 1 is the same as 4, and each is smaller than 2 or 3.
 - F. The potential difference across 1 is largest, 4 is next largest. 2 is the same as 3, and each is smaller than 4.
 - J. None of these is correct.

Check the potential difference by attaching the voltmeter on either side of each bulb.

Across Bulb 1: _____ V Bulb 2: _____ V Bulb 3: _____ V Bulb 4: _____ V

Now calculate the voltage drop for each bulb. $V = IR$ Use the values for I_1 , I_2 , I_3 , and I_4 above. The resistance of each bulb is $10\ \Omega$.

Across Bulb 1: _____ Bulb 2: _____ Bulb 3: _____ Bulb 4: _____

4. What happens to the current through bulb 1 if the switch, S, is opened?
- A. It increases.
 - B. It remains the same.
 - C. It decreases.
 - D. Not enough information is given.

Open the switch in the PhEt circuit. Measure and record the new current across Bulb 1. _____

5. What happens to the current through bulb 2 if the switch, S, is opened?
- A. It increases.
 - B. It remains the same.
 - C. It decreases.
 - D. Not enough information is given.

Measure and record the current across Bulb 2: _____

6. Based on your answer for items (4) and (5) compare the current through Bulb 2 with the switch, S, opened to the current through Bulb 1 before the switch was opened.

- A. The current through bulb 2 now equals the current through bulb 1 before S was opened.
- B. The current through bulb 2 now is more than half the current through bulb 1 before S was opened.
- C. The current through bulb 2 now is half the current through bulb 1 before S was opened.
- D. The current through bulb 2 now is less than half the current through bulb 1 before S was opened.
- E. Not enough information is given.
- J. None of these is correct.

Bulb 2 with switch open: _____ Bulb 1 before switch was opened _____

7. Bulbs 2 and 3 are connected
- A. In series.
 - B. In parallel.
 - C. In series and parallel.
 - D. Neither in series nor parallel.
8. Bulbs 1 and 3 are connected
- A. In series.
 - B. In parallel.
 - C. In series and parallel.
 - D. Neither in series nor parallel.